



ZIMBABWE

**MINISTRY OF HIGHER AND TERTIARY EDUCATION,
INNOVATION, SCIENCE AND TECHNOLOGY
DEVELOPMENT**

**HIGHER EDUCATION EXAMINATIONS COUNCIL
(HEXCO)**

NATIONAL DIPLOMA

IN

APPLIED CHEMICAL TECHNOLOGY

**MODULE: Process Instrumentation and
Control I**

PAPER NO: 501/23/M03

DURATION: 3 Hours

JUNE 2026 EXAMINATION

REQUIREMENTS

1. Scientific calculator.
2. Answer booklet.

INSTRUCTIONS TO CANDIDATE

1. Answer any five (5) questions.
2. Each question carries twenty (20) marks.

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QUESTION 1

- a) Define the following terms as they are used in process instrumentation and control
- i) Response time (2 marks)
 - ii) Lag (2 marks)
 - iii) Fidelity (2 marks)
 - iv) Speed of response (2 marks)
- b) Explain the sources of the following two measurements of a physical quantity
- i) Systematic error (2 marks)
 - ii) Random error (2 marks)
- c) Distinguish between static and dynamic characteristics of measuring instruments. (4 marks)
- d) The volume, V of a cylinder of length, L and radius, R is given by the equation

$$V = \pi R^2 L$$

Calculate the radius of the cylinder and its uncertainty given that

$$V = (25.0 \pm 0.3)m^3$$

$$L = (20.0 \pm 0.1)cm \quad (4 \text{ marks})$$

QUESTION 2

- a) Discuss the basic requirements of a good quality transducer. (5 marks)
- b) Distinguish active transducer from passive transducer. (4 marks)
- c) i) With the aid of a diagram explain the principle of operation of a venturimeter. (7 marks)
- ii) A venturimeter has a cross-sectional area of $2 \times 10^{-3}m^2$ and $4.6 \times 10^{-4} \times m^2$ in the wider and narrow area respectively. The velocity of liquid in wider area is 0.45 ms^{-1}

Calculate the velocity of fluid in the narrow area. (4 marks)

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QUESTION 3

- a) Explain five (5) factors which contribute to drift instruments. (10 marks)
- b) i) Given thermometer with absolute error of $\pm 0.2^{\circ}\text{C}$. Determine the temperature range when the thermometer gives a reading of 39.5°C when, measuring temperature. (2 marks)
- ii) Determine the static error when a thermometer reads 38.5°C , given that the actual value of temperature value is 38.2°C (2 marks)
- c) Define the following terms as used in process instrument control
- i) Sensitivity (2 marks)
- ii) Resolution (2 marks)
- iii) Span (2 marks)

QUESTION 4

- a) Compare closed loop and open loop system. (8 marks)
- b) Discuss the following
- i) Proportional control mode (3 marks)
- ii) Integral control mode (3 marks)
- iii) Derivative control mode (3 marks)
- iv) Composite control mode (3 marks)

QUESTION 5

Discuss four (4) main functions performed by instruments. (20 marks)

QUESTION 6

- a) Distinguish the following classes of measuring instruments:
- i) Absolute (primary) and secondary (4 marks)
 - ii) Indicating and recording (4 marks)
 - iii) Mechanical and electronic (4 marks)
- b) Illustrate analogue to digital conversion. (8 marks)

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